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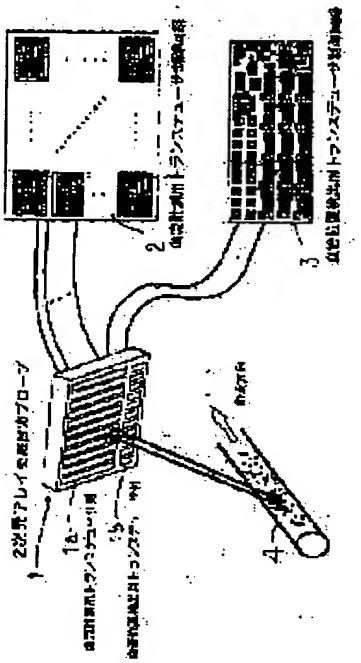
(72)Inventor : HIRAO TOMOJI
KIUCHI YOSUKE

(54) AUTOMATIC POSITION CHASING ULTRASONIC BLOODSTREAM MEASURING INSTRUMENT

(57)Abstract:
PROBLEM TO BE SOLVED: To provide a bloodstream measuring instrument which surely measures the bloodstream at object blood vessel even a subject changes position and moves, and effective for prevention and early detection of blood vessel disease.
SOLUTION: A plurality of oscillation elements of an ultrasonic probe 1 are arrayed two dimensionally in not less than two rows and two columns, and at least one column 1a of the oscillation element has a blood vessel position measuring means 2. By the blood vessel position measuring means 2, another row 1b of the oscillation elements controls the position of ultrasonic beam irradiation and detecting time variably, and by the above, it is constituted so as to measure only the bloodstream information in blood vessel.



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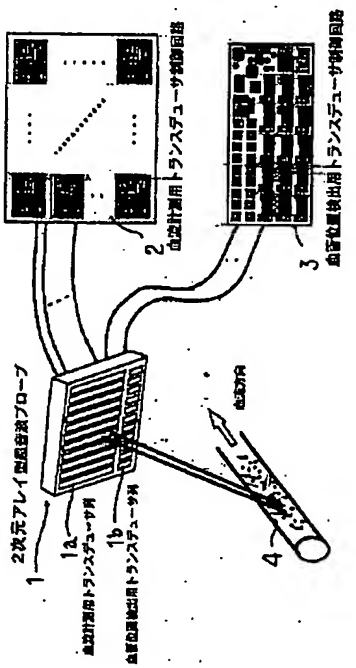
Ｆターム(参考)　4C301 DD04 EE13 GA20 GB09 JB08 JB23

(54)【発明の名称】　位置自動追尾型超音波血流計測装置

(57)【要約】
【課題】被験者が姿勢を変えたり運動するなどの動きを伴ったとしても対象血管の血流を適確に計測することができ、血管性疾患の予防、早期発見などに有効ならしめる。
【解決手段】複数の振動子を２段（列）２行以上の２次元アレイ状に配列した超音波プローブ１であって、前記振動子の中の少なくとも１つの列１ａが計測対象血管位置を測定する血管位置測定手段２を有し、この血管位置測定手段２によって前記振動子の中の他の１つの列１ｂが超音波ビーム照射位置と検出時間を可変制御することにより、血管内の血流情報のみを計測するように構成した。



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【特許請求の範囲】

【請求項１】被検体の血管内血流情報を計測する超音波血流計において、振動子を縦方向に２段以上、かつ横方向に複数個直線上に配列した２次元アレイ型超音波プローブと、このプローブを制御する制御手段とを備え、前記振動子の中の少なくとも１つの列は計測対象血管位置を測定する血管位置測定手段を有すると共に、この血管位置測定手段によって得た情報を基に前記振動子の中の他の少なくとも１つの列が超音波ビーム照射位置と検出時間を可変制御することにより血管内の血流情報のみを計測するように構成されていることを特徴とする位置自動追尾型超音波血流計測装置。

【請求項２】横方向複数個以上の列で構成された超音波プローブが縦方向に上段と下段よりなり、下段の超音波素子を血管位置検出用超音波送受信部とし、上段の超音波素子を血流速度検出用超音波送受信部とする請求項１記載の位置自動追尾型超音波血流計測装置。

【発明の詳細な説明】

【０００１】

【発明の属する技術分野】本発明は超音波診断装置、特に反射エコー信号に基づいて生体内の血流情報を計測する超音波血流計測装置に係り、詳しくは血管位置の検出と血管の自動追尾が可能で、運動中でも血管血流の計測を実現する位置自動追尾型超音波血流計測装置に関するものである。

【０００２】

【従来の技術】従来、医用分野で用いられている超音波診断装置は、人体の表面に超音波送信用プローブと、受信用プローブを測定しようとする人体の両端に配置し、パルス発振器により送信用プローブから体内に超音波パルスを送り、この超音波パルスが体内を伝播し、受信用プローブに到達したときの状態を検知して内蔵器官部位の断層データをリアルタイムでモニタ表示したり、またパルスドプラ法を用いて特定血管部位の血流速度を測定し、この速度分布や平均血流速度をモニタ表示することなどを行っている。また、断層情報をモニタに表示すると共に、断層情報が表示されたモニタの関心領域に血流情報を並べて表示するようにしたものも知られている。

【０００３】更に一方、超音波プローブとして広帯域化をはかり、広い周波数領域にわたって高い信号を得るため複数の振動子をアレイ状に配列した超音波プローブを用いることは特開平１１－７６２３９号公報に開示されている。

【０００４】

【発明が解決しようとする課題】しかし、上述した従来の超音波診断装置、特に血流状態を計測する超音波血流計測装置は、生体内の血流状態を計測するにあたり、静止状態にあってはそれに応じた計測値が得られるとしても、運動に伴って表皮上につけられたプローブと、生体内部の血管との相対位置関係が変化することに対して、

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位置を検出する機能を有していないため、表皮につけられたプローブと、生体内部の血管との相対位置関係が変化するような場合には照射された超音波の焦点領域外に動脈血管が移動することにより表皮上のプローブで計測することが出来なくなるという問題があった。

【０００５】更に運動に伴い表皮につけられたプローブと、生体内部の血管との相対位置関係の変化量を検出し、超音波の照射位置を変えることができないために、運動に伴う筋ポンプ現象などの影響により対象動脈血管外の組織が運動し、音響ノイズを生じ、この影響を大きく受けることによって計測出来ないという問題もあった。

【０００６】本発明は上述の如き従来の装置による問題を解決すべく、特に新規な超音波プローブの利用を見出すことにより計測対象血管位置の検出と、血管の自動追尾を可能として、被験者が姿勢を変えたり運動するなどの動きを伴ったとしても対象血管の血流を計測することができ、血管性疾患の予防、早期発見などに有効ならしめることを目的とするものである。

【課題を解決するための手段】

【０００７】即ち、上記目的に適合するため本発明は、被検体の血管内血流情報を計測する超音波血流計において、振動子を縦方向に２段以上、かつ横方向に複数個直線上に配列した２次元アレイ型超音波プローブと、このプローブを制御する制御手段とを備え、前記振動子の中の少なくとも１つの列は計測対象血管位置を測定する血管位置測定手段を有していると共に、この血管位置測定手段によって得た情報に基づき前記振動子の中の他の少なくとも１つの列が超音波ビーム照射位置と検出時間を可変制御することにより血管内の血流情報のみを計測し得るように構成されている点にある。

【０００８】請求項２は超音波プローブの具体的構成であり、横方向複数個以上で構成された超音波プローブが縦方向上段と下段の２段となっており、下段の超音波素子が血管位置検出用超音波送受信部であり、上段の超音波素子が血流速度検出用超音波送受信部であることを特徴とする。

【０００９】

【発明の実施の形態】以下、更に添付図面にもとづいて本発明の詳細を説明する。

【００１０】図１は本発明に係る超音波血流計測装置の概要を示し、図において１は２次元アレイ型の超音波プローブ、２は超音波パルス放射後の時間の経過に対応した信号を出力する血流計測用トランスデューサ制御回路、３は同じく超音波放射後の時間の経過に対応した信号を出力する血管位置検出用トランスデューサ制御回路であり、超音波プローブ１は図示の如く縦方向には上段１ａと下段１ｂの２段で、横方向には複数個が並列された各トランスデューサ列よりなるリニアアレイ型の超音波プローブとなっていて、上段１ａの血流計測用トラン

ステューサ列は血流計測用の制御回路２に、一方、下段１ｂの血管位置検出用トランステューサ列は血管位置検出用の制御回路３に夫々連結されている。なお、超音波プローブの段数及び列数は必ずしも図示例に限らず、縦方向に３段以上、横方向に適宜の列数として構成することも可能である。

【００１１】そして、超音波プローブ１は図示のように動脈血管４に対向して配置され、上段又は下段の超音波素子より夫々超音波パルスを矢示の如く発信し、動脈血管４で反射してその反射波を矢示のように同じ上段又は下段の超音波素子で受信するが、例えばプローブ１を上腕部などの表皮部に取り付け、腕内部の上腕動脈血管を狙うものとすると、例えば下段１ｂを位置検出用超音波送受信部、上段１ａを血流速度検出用超音波送受信部とする。

【００１２】図２は上記超音波プローブ１を用いて下段１ｂにより血管位置の検出をする原理を示し、（イ）図に示すように下段の超音波素子から同時刻に超音波インパルスを発信すると、超音波インパルスａは動脈血管４で反射してその反射波ｂが矢示の如く同じ下段の超音波素子で受信される。即ち、各素子（振動子）から発信された探信音波ａは血管壁で反射し、血管径に応じた幅の反射波ｂが所要の素子（振動子）に受信され、このとき、動脈４からの反射は血管の直上の素子でのみ強く受信され、他の素子ではほとんど受信されない。従って、これによって血管の位置が推定できる。また、音波の進行速度は時間と距離に比例しているため、送信時刻と受信時刻の差が血管までの距離となる。更に（ロ）図の如き発信された超音波パルスａは表皮で反射波形ｂ。として反射されると共に血管壁で反射されるが、血管は円筒形の壁を持っているため、理想的には（ハ）図の如くその表皮に近い側（血管前壁）とその反対側の遠い側（血管後壁）の２つの反射波形b_1，b_2が確認できる。従って、受信された２つの反射波b_1，b_2の差が血管径となる。かくして、以上より、血管の位置と深さと直径を検出することができる。

【００１３】図３は上記図２における血管位置検出で得た情報を基にして血流計測を行う原理を示しており、上記情報を基に上段１ａの超音波素子列の中で前記の血管直上に相当する超音波素子から図３（イ）のような超音波パルスｃを表皮５を通じて発信する。発信された超音波パルスｃは血管４に至るまでの細胞組織の運動（血管外組織の運動）と血管内を流れる血流の双方の運動速度を反映したドップラ偏移反射を経て発信した超音波素子で反射波ｄとして受信される。このとき、図３（ロ）のように前記図２（ハ）で得られた血管直上での受信波形である２つの反射波b_1，b_2（血管径に相当）でゲートを掛けて取り出してやると、ゲートを掛けて取り出された波形部分w_1は音波の時間距離関係から血管内部での反射のみを抽出することが出来る。なお、w_2は血管外組織からの超音波エコーである。以上のことから、血管位置の検出と血管の自動追尾が可能となり、運動による音響雑音を受けにくい血流計測が実現できる。

【００１４】かくして、本発明は２つの異なった制御機構を有する列上に配された超音波素子を１つのプローブ内に構成し、列上に配された超音波素子の１群をもって生体内の血管の位置と、深さと直径を計測し、これを基にして他群の超音波素子を制御することにより血管内に相当する領域からの反射音のみを抽出することによって運動に伴う音響のノイズの影響を除去し、運動中の生体内の血管血流の計測を実現することができる。

【００１５】

【発明の効果】本発明は以上のように複数の振動子を２段２行以上の２次元アレイ状に配列した超音波プローブであって、前記振動子の中の少なくとも１つの列が計測対象血管位置を測定する血管位置測定手段を有していると共に、この血管位置測定手段によって前記振動子の中の他の少なくとも１つの列が超音波ビーム照射位置と検出時間を可変制御することにより、血管内の血流情報のみを計測できるようにしたものであり、１つの列の血管位置測定手段の振動子から発信された音波が血管壁で反射し、血管径に応じた幅で、かつ表皮側血管壁と内側血管壁からの反射波として振動子に受信されることから、血管の位置と深さと直径を検出でき、これにもとづいて他の列の振動子を制御することによって血管内に相当する領域から反射音のみを抽出することができるので、運動中であるとしても運動による音響雑音を除去して正確な生体内血管血流の計測を実現することができる顕著な効果を有し、医療分野において動脈梗塞や閉塞・狭窄などの血管性疾患の予防・早期発見のための運動負荷試験等に利用でき、また、手術中の患者の血流状態モニタに利用できる外、定期健康診断やリハビリなどへの適用も考えられるなど、種々の実効が期待できる。

【００１６】しかもまた、本発明は基礎医学分野においては、運動中の血流の変化等の解明、運動血管性疾患・貧血などの発生メカニズムの解明にも利用することができると共に、体力医学分野においても、アスリート達のトレーニング効果の評価や効果的トレーニングや運動に伴う血流のダイナミクスの解明に効果的であり、日常生活においては、健康管理や体力増進のために行う運動の安全性の確保ならびに独居老人の生存確認などへの応用も考えられるメリットを有している。

【図面の簡単な説明】

【図１】本発明に係る超音波プローブの概要を示す説明図である。

【図２】血管位置の検出原理を示す概要図で、（イ）は下段の超音波素子からのバルスの発信、受信の態様を示し、（ロ）（ハ）は各波形の態様で、（ロ）は各素子からの送信波形、（ハ）は血管直上での受信波形である。

【図３】血流の計測原理を示す概要図で、（イ）は上段

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の超音波素子からのパルスの発信、受信の態様を、（ロ）はゲートをかけて取り出す受信波形の態様を示す。

【符号の説明】

１　超音波プローブ

１ａ　上段超音波素子（血流計測用トランスデューサ列）

＊１ｂ　下段超音波素子（血管位置検出用トランスデューサ列）

２　血流計測用トランスデューサ制御回路

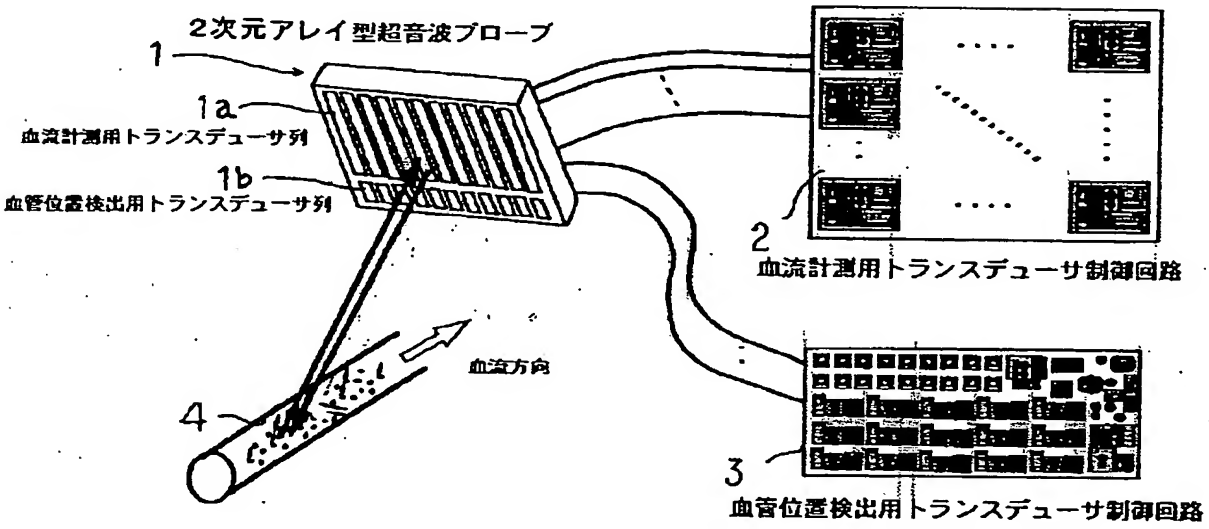
３　血管位置検出用トランスデューサ制御回路

４　動脈血管

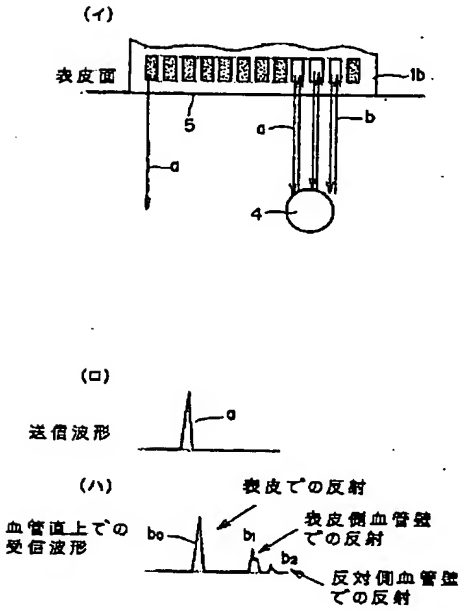
５　表皮部

＊

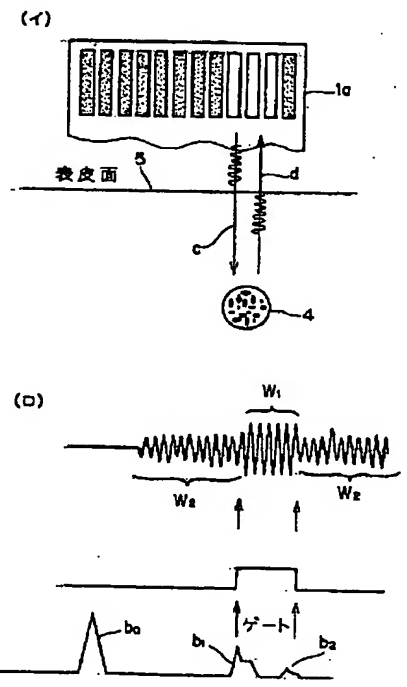
【図１】



【図２】



【図３】



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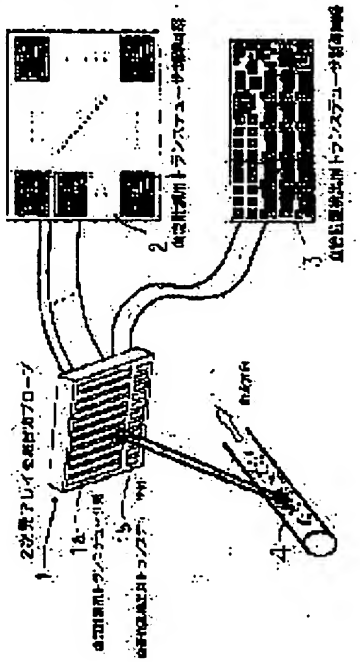
SOLUTION: A plurality of oscillation elements of an ultrasonic probe 1 are arrayed two dimensionally in not less than two rows and two columns, and at least one column 1a of the oscillation element has a blood vessel position measuring means 2. By the blood vessel position measuring means 2, another row 1b of the oscillation elements controls the position of ultrasonic beam irradiation and detecting time variably, and by the above, it is constituted so as to measure only the bloodstream information in blood vessel.



LEGAL STATUS

[Date of request for examination]	29.06.2000
[Date of sending the examiner's decision of rejection]	
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[Date of final disposal for application]	
[Patent number]	3378941
[Date of registration]	13.12.2002
[Number of appeal against examiner's decision of rejection]	
[Date of requesting appeal against examiner's decision of rejection]	
[Date of extinction of right]	

* NOTICES *

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CLAIMS

[Claim(s)]
[Claim 1] The two-dimensional-array mold supersonic-wave probe which arranged to two or more steps in the lengthwise direction, and arranged two or more vibrator on the straight line in the longitudinal direction in Doppler rheograph which measures the blood-flow information in a blood vessel on analyte, Have the control means which controls this probe, and while at least one train in said vibrator has a blood vessel location measurement means to measure the blood vessel location for measurement The location automatic-tracking mold supersonic-wave blood-flow metering device characterized by being constituted so that only the blood-flow information in a blood vessel may be measured, when other at least one train in said trembler carries out adjustable control of an ultrasonic beam exposure location and the detection time based on the information acquired with this blood vessel location measurement means.
[Claim 2] The location automatic-tracking mold supersonic-wave blood-flow metering device according to claim 1 which the ultrasonic probe which consisted of trains more than longitudinal direction plurality becomes a lengthwise direction from an upper case and the lower berth, makes the ultrasonic component of the lower berth the ultrasonic transceiver section for blood vessel location detection, and makes the ultrasonic component of an upper case the ultrasonic transceiver section for flow-velocity detection.

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DETAILED DESCRIPTION

[Detailed Description of the Invention]
[0001]
[Field of the Invention] This invention relates to an ultrasonic diagnostic equipment, especially the ultrasonic blood-flow metering device which measures blood-flow information in the living body based on a reflective echo signal, and detection of a blood vessel location and automatic tracking of a blood vessel are possible for it in detail, and it relates to the location automatic-tracking mold supersonic-wave blood-flow metering device which realizes measurement of a blood vessel blood flow also in motion.
[0002]
[Description of the Prior Art] Conventionally the ultrasonic diagnostic equipment used in the medical field It arranges to the ends of the body which is going to measure the probe for ultrasonic transmission, and the probe for reception on the surface of the body. An ultrasonic pulse inside of the body from the probe for transmission with a pulse oscillator Delivery, This ultrasonic pulse spreads the inside of the body, and the condition when reaching the probe for reception is detected. The fault data of a built-in organic part a monitor table on real time it is shown or Moreover, the flow velocity of a specific blood vessel part is measured using a pulse Doppler system, and it is performing carrying out the monitor display of this velocity distribution and average flow velocity etc. Moreover, while displaying fault information on a monitor, what displayed blood-flow information on the area of interest of the monitor with which fault information was displayed side by side is known.
[0003] Furthermore, on the other hand, in order to acquire a high signal for broadband-ization over a scale and a large frequency domain as an ultrasonic probe, using the ultrasonic probe which arranged two or more tremblers in the shape of an array is indicated by JP,11-76239,A.
[0004]
[Problem(s) to be Solved by the Invention] However, the conventional ultrasonic diagnostic equipment mentioned above, especially the ultrasonic blood-flow metering device which measures a blood-flow condition If it is in a quiescent state, though the measurement value according to it is obtained in measuring a blood-flow condition in the living body Since it does not have the function to detect a location, to the relative-position relation between the probe attached on epidermis with motion and the blood vessel inside a living body changing, When the relative-position relation between the probe attached to epidermis and the blood vessel inside a living body changed, and arterial blood tubing moved out of the focal field of the irradiated supersonic wave, there was a problem of it becoming impossible to measure with the probe on epidermis.
[0005] furthermore , since variation of the relative position relation between the probe attached to epidermis with motion and the blood vessel inside a living body be able to be detected and the exposure location of a supersonic wave be able to be changed , the organization besides object arterial blood tubing exercised under the effect of the muscle pump phenomenon accompanying motion etc. , the sound noise be produced , and there be also a problem that it be immeasurable by this be influence greatly .
[0006] detection of the blood vessel location for measurement and automatic tracking of a blood vessel be enable by find out utilization of a new ultrasonic probe especially , that this invention should solve the problem by the conventional equipment like **** , even if a test subject change a position or it be accompany by the motion of exercise , the blood flow of an object blood vessel can be measure , and it aim at close , if in prevention of a blood vessel nature disease , early detection , etc.
[Means for Solving the Problem]
[0007] Namely, since the above-mentioned object is suited, this invention is set to Doppler rheograph which measures the blood-flow information in a blood vessel on analyte. The two-dimensional-array mold

supersonic-wave probe which arranged to two or more steps in the lengthwise direction, and arranged two or more vibrator on the straight line in the longitudinal direction, Have the control means which controls this probe, and while at least one train in said vibrator has a blood vessel location measurement means to measure the blood vessel location for measurement When other at least one train in said vibrator carries out adjustable control of an ultrasonic PIMU exposure location and the detection time based on the information acquired with this blood vessel location measurement means, it is in the point constituted so that only the blood-flow information in a blood vessel can be measured.

[0008] Claim 2 is the concrete configuration of an ultrasonic probe, and the ultrasonic probe constituted above longitudinal direction plurality is a lengthwise direction upper case and two steps of the lower berth, and the ultrasonic component of the lower berth is the ultrasonic transceiver section for blood vessel location detection, and it is characterized by the ultrasonic component of an upper case being the ultrasonic transceiver section for flow-velocity detection.

[0009]

[Embodiment of the Invention] Hereafter, based on an accompanying drawing, the detail of this invention is explained further.

[0010] Drawing 1 shows the outline of the ultrasonic blood-flow metering device concerning this invention, and sets it to drawing. 1 The ultrasonic probe of a two-dimensional-array mold, The transducer control circuit for blood-flow measurement where 2 outputs the signal corresponding to the passage of time after ultrasonic pulse radiation, 3 is a transducer control circuit for blood vessel location detection which similarly outputs the signal corresponding to the passage of time after acoustic emission, and the ultrasonic probe 1 is two steps, upper case 1a and lower-berth 1b, in a lengthwise direction like a graphic display. It is the ultrasonic probe of the linear array mold which becomes a longitudinal direction from each transducer train by which plurality was arranged in parallel. On the other hand, the transducer train for blood vessel location detection of lower-berth 1b is connected with the control circuit 2 for blood-flow measurement in the transducer train for blood-flow measurement of upper case 1a in the control circuit 3 for blood vessel location detection, respectively. In addition, not only the example of a graphic display but the number of stages and the number of trains of an ultrasonic probe can not necessarily be constituted in a lengthwise direction as the number of trains proper in three or more steps and a longitudinal direction.

[0011] And although the ultrasonic probe 1 counters the arterial blood tubing 4 like a graphic display, and is arranged, an ultrasonic pulse is sent like ****, is reflected with the arterial blood tubing 4 from the ultrasonic component of an upper case or the lower berth, respectively and the reflected wave is received with the ultrasonic component of the same upper case or the lower berth like **** For example, if overarm arterial blood tubing inside installation and an arm shall be aimed at for a probe 1 in the epidermis sections, such as the overarm section, let the ultrasonic transceiver section for location detection, and upper case 1a be the ultrasonic transceiver sections for flow-velocity detection, for example for lower-berth 1b.

[0012] If drawing 2 sends an ultrasonic impulse to this time of day from the ultrasonic component of the lower berth as the principle which detects a blood vessel location by lower-berth 1b using the above-mentioned ultrasonic probe 1 is shown and it is shown in (b) drawing, the ultrasonic impulse a will be reflected with the arterial blood tubing 4, and the reflected wave b will be received with the ultrasonic component of the same lower berth like ****. That is, the **** acoustic wave a sent from each component (vibrator) is reflected with a blood vessel wall, the reflected wave b of width of face according to the diameter of a blood vessel is received by the necessary component (vibrator), at this time, it is strongly received only with the component of the right above of a blood vessel, and the echo from an artery 4 is hardly received with other components. Therefore, the location of a blood vessel can be presumed by this. Moreover, since the speed of advance of an acoustic wave is proportional to time amount and distance, the difference of transmitting time of day and the receipt time serves as distance to a blood vessel. furthermore, (**) -- while the sent ultrasonic pulse a like drawing is reflected as a reflected wave form b0 with epidermis, it is reflected with a blood vessel wall, but since the blood vessel has the wall of a cylindrical shape, as shown in drawing (Ha), two reflected wave forms b1 and b2 of a far side (blood vessel posterior wall of stomach) of the opposite hand can be checked the side (blood vessel front wall) near the epidermis ideally. Therefore, the difference of two received reflected waves b1 and b2 serves as a diameter of a blood vessel. In this way, the location, the depth, and the diameter of a blood vessel are detectable from the above.

[0013] Drawing 3 shows the principle which performs blood-flow measurement based on the information acquired by the blood vessel location detection in above-mentioned drawing 2 , and sends an ultrasonic pulse c like drawing 3 (b) through epidermis 5 from the ultrasonic component which is equivalent to right above [above / blood vessel] in the ultrasonic element array of upper case 1a based on the above-

mentioned information. The sent ultrasonic pulse c is received as a reflected wave d with the ultrasonic component sent through the Doppler shift echo reflecting the motion velocity of motion (motion of an outside-of-the-blood-vessel organization) of a cellular structure until it results in a blood vessel 4, and the both sides of a blood flow which flow the inside of a blood vessel. If the gate is hung and taken out by two reflected waves b1 and b2 (equivalent to the diameter of a blood vessel) which are the received waves of the blood vessel right above obtained by said drawing 2 (Ha) like the drawing 3 (**) at this time, the wave part w1 which hung the gate and was taken out can extract only the echo inside a blood vessel from the time distance relation of an acoustic wave. In addition, w2 is an ultrasonic echo from an outside-of-the-blood-vessel organization. Detection of a blood vessel location and automatic tracking of a blood vessel are attained from the above thing, and blood-flow measurement which cannot receive acoustic noise by motion easily can be realized.

[0014] In this way, this invention constitutes the ultrasonic component allotted on the train which has two different controlling mechanisms in one probe, and has one group of the ultrasonic component allotted on the train. The location of a blood vessel in the living body, The depth and a diameter are measured, by extracting only the reflected sound from the field which corresponds in a blood vessel by controlling the ultrasonic component of other groups based on this, the effect of the noise of the sound accompanying motion can be removed, and measurement of the blood vessel blood flow in the living body under motion can be realized.

[0015]

[Effect of the Invention] While this invention has a blood vessel location measurement means by which two or more tremblers were arranged as mentioned above in the shape of [two step / of two or more lines] a two dimensional array and by which are an ultrasonic probe and at least one train in said trembler measures the blood vessel location for measurement When other at least one train in said trembler carries out adjustable control of an ultrasonic beam exposure location and the detection time with this blood vessel location measurement means Enable it to measure only the blood-flow information in a blood vessel, and the acoustic wave sent from the vibrator of the blood vessel location measurement means of one train reflects with a blood vessel wall, and by the width of face according to the diameter of a blood vessel and from being received by vibrator as a reflected wave from an epidermis side blood vessel wall and an inside blood vessel wall Since only a reflected sound can be extracted from the field which corresponds in a blood vessel by being able to detect the location, the depth, and the diameter of a blood vessel and controlling the vibrator of other trains based on this It has the remarkable effectiveness that the acoustic noise by motion can be removed and measurement of an exact blood vessel blood flow in the living body can be realized though it is under motion. Various efficiency -- the application to a regular health check, rehabilitation, etc. is also considered -- is expectable the outside which can use for the exercise stress test for prevention and early detection of blood vessel nature diseases, such as artery infarction, and lock out, a constriction, etc. in the medical field, and can be used for the blood-flow condition monitor of the patient under operation.

[0016] And this invention is set in the experimental medicine field again. While being able to use also for a break through of generating mechanisms, such as a break through of change of the blood flow under motion etc., and a motion blood vessel nature disease, ischemia Also in the medicine-for-physical-fitness field, it is effective for a break through of the dynamics of the blood flow accompanying assessment and effective training of athletes' training effect, or motion, and sets to everyday life. It has the merit the application to the health care, reservation of the safety of the motion of physical strength improvement performed for accumulating, a survival check of old people living alone, etc. is also considered to be.

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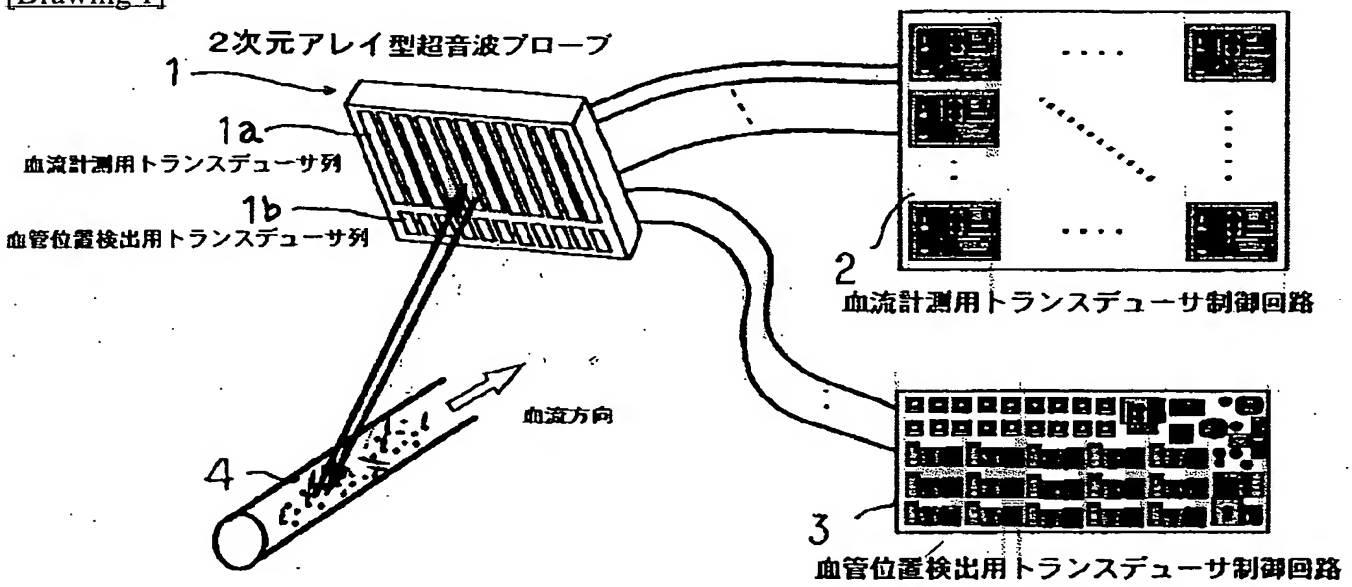
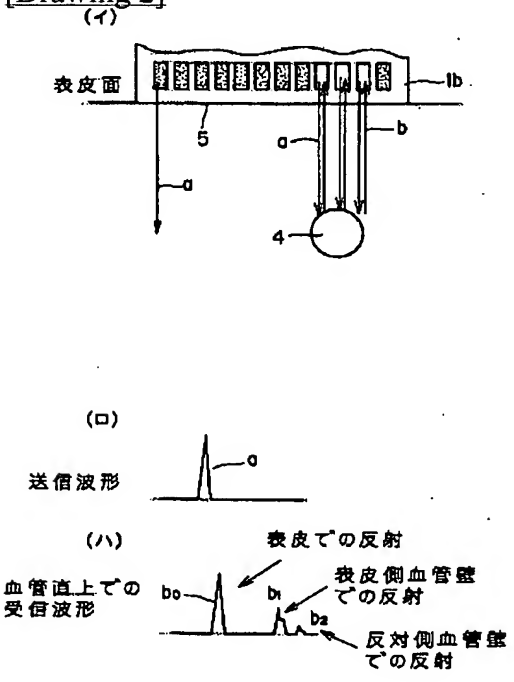
DRAWINGS

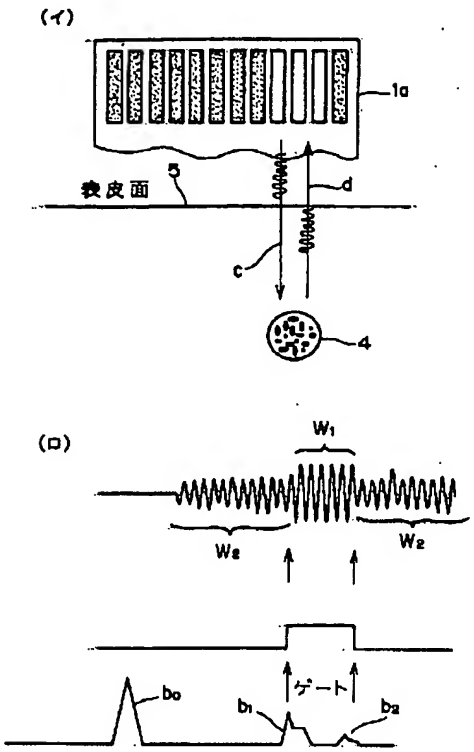
[Drawing 1]



[Drawing 2]



[Drawing 3]



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